

IN THE CLAIMS:

1 1-22. (Cancelled).

1 23. (Currently Amended) A storage ~~controller~~ system, comprising:
2 a destination to store a snapshot from a source;
3 a process to initiate a snapshot operation of the source, the snapshot having a
4 snapshot range of data bytes of the source;
5 a write request to modify a range of data bytes of the source;
6 the storage system to determine if the range of data bytes are within the snapshot
7 range;
8 a first write request to write to first data blocks, the first data blocks already cop-
9 ied in the snapshot;
10 in response to determining that the range of data bytes are in the snapshot range,
11 the storage system to determine if the range of data bytes have been written to the snap-
12 shot;
13 in response to determining that the range of data bytes have been written to the
14 snapshot, the first write request to be written to the source; and
15 in response to determining that the range of data bytes have not been written to
16 the snapshot, the process first to copy the range of data bytes of the source to the snap-
17 shot, and then the process to write the write request to the source.
18 a second write request to write to second data blocks, the second data blocks not
19 already copied in the snapshot;
20 the second write request being placed into a first in first out queue; and

21 in response to completing the snapshot, the second write request being written
22 from the first in first out queue to the source.

1 24. (Currently Amended) The storage device controller system of claim 23, further
2 comprising:
3 wherein the storage device controller is a RAID system controller.

1 25. (Currently Amended) The storage device controller system of claim 23, further
2 comprising: wherein:

3 the range of the source specified by the snapshot command is a first range, and the
4 write command request specifies a second range of data bytes of the source volume; and
5 the controller storage system is operable, in response to receiving the write com-
6 mand request while the source volume is being copied to the destination target volume, to
7 hold the write command request in the a cache, check if the first range overlaps with the
8 second range and, if so, copy the second range from the source volume to the snapshot
9 volume, update the a snapshot map, and then allow the write command request to write
10 the source volume.

1 26. (Currently Amended) The storage device controller system of claim 23, further
2 comprising:

3 wherein the replication manager process is executed on a file server.

1 27. (Currently Amended) The storage device controller system of claim 26, further
2 comprising:

3 wherein the file server is connected to a storage area network switch and the file
4 server communicates with the storage ~~device controller~~ system through the storage area
5 network switch.

1 28. (Currently Amended) The storage ~~device controller~~ system of claim 23, further
2 comprising:

3 wherein the ~~replication manager~~ process is operable to control multiple storage
4 ~~device controllers~~ systems.

1 29. (Currently Amended) The storage ~~device controller~~ system of claim 23, further
2 comprising wherein:

3 the ~~one or more storage device commands~~ write request includes include SCSI
4 commands.

1 30. (Currently Amended) The storage ~~device controller~~ system of claim 23, further
2 comprising wherein:

3 the ~~controller storage system~~ is operable to send the one or more ~~storage device~~
4 commands by using one of an in-band protocol or an out-of-band protocol.

1 31. (Currently Amended) A method comprising:

2 starting a snapshot command from a source to a destination, the snapshot com-
3 mand specifying a snapshot range of data bytes of the source;

4 in response to receiving the snapshot command, a ~~storage device controller~~ taking
5 a snapshot of the snapshot range specified using a device control command to control one
6 or more devices on which the source is stored, the snapshot including a snapshot map and

7 snapshot data; and storing the snapshot map and the snapshot data in a cache internal to
8 the storage device controller and snapshot volume, respectively;

9 receiving a first write request to modify a range of first data blocks, the first data
10 blocks already copied in the snapshot bytes of the source;

11 determining if the range of data bytes are within the snapshot range;

12 determining, in response to the range of data bytes being in the snapshot range, if
13 the range of data bytes has been written to the snapshot;

14 writing, in response to the range of data bytes having been written to the snapshot,
15 the first write request to the source; and

16 copying, in response to the range of data bytes having not been written to the
17 snapshot, the range of data bytes to the snapshot, and then writing the write request to the
18 source

19 receiving a second write request to write to second data blocks, the second data
20 blocks not already copied in the snapshot;

21 placing the second write request into a first in first out queue; and

22 writing, in response to completing the snapshot, the second request from the first
23 in first out queue to the source.

1 32. (Currently Amended) The method of claim 31, further comprising wherein:
2 the storage device is using a RAID system as the source controller.

1 33. (Currently Amended) The method of claim 31, wherein the range specified by the
2 snapshot command is a first range, the method further comprising:

3 receiving at the source storage controller device a the write request command is-
4 sued from a file system, the write command request specifying a second first range of

5 data bytes of the source volume, the write copy command request being received while
6 the source volume is being copied to the destination target volume;
7 in response to receiving the write request command, the storage device controller
8 holding the write request command in the a cache, checking if the first range overlaps
9 with the second the range specified by the snapshot range and, if so, copying the first see-
10 ond range from the source volume to the snapshot volume, updating the snapshot map,
11 and then allowing the write request command to write to the source volume.

1 34. (Currently Amended) The method of claim 31, further comprising:
2 wherein executing the snapshot command by a replication manager is executed on
3 a file server.

1 35. (Currently Amended) The method of claim 31, further comprising:
2 wherein the connecting a file server is connected to a storage area network switch
3 and the file server communicates with the a storage device controller system through the
4 storage area network switch to execute the snapshot command the storage system.

1 36. (Currently Amended) The method of claim 31, further comprising:
2 wherein controlling multiple storage device controllers by a the replication man-
3 ager is operable to control multiple storage device controllers.

1 37. (Currently Amended) The method of claim 31, further comprising: wherein
2 the storage device commands include including a SCSI command in the write re-
3 quest.

1 38. (Currently Amended) The method of claim 31, further comprising:
2 wherein sending the a storage device system commands are sent using one of an
3 in-band protocol or an out-of-band protocol.

1 39. (Currently Amended) A computer-implemented method comprising:
2 starting a snapshot from a source to a destination, the snapshot having a snapshot
3 range of data bytes of the source;
4 receiving a first write request to first modify a range of data blocks bytes of the
5 source, the first data blocks already copied in the snapshot;
6 determining if the range of data bytes are within the snapshot range;
7 determining, in response to the range of data bytes being in the snapshot range, if
8 the range of data bytes have been written to the snapshot;
9 writing, in response to the range of data bytes having been written to the snapshot,
10 the first write request to the source; and
11 copying, in response to the range of data bytes not being written to the snapshot,
12 the range of data bytes of the source to the snapshot, and then writing the write request to
13 the source
14 receiving a second write request to write to second data blocks, the second data
15 blocks not already copied in the snapshot;
16 placing the second write request in a first in first out
17 writing, in response to completing the snapshot, the second write request from the
18 first in first out queue to the source.

1 40. (Currently Amended) A system comprising:
2 a destination to store a snapshot from a source;

3 a process to initiate a snapshot operation of the source, the snapshot having a
4 snapshot range;
5 a write request to modify a range of data bytes of the source;
6 the system to determine if the range of data bytes are within the snapshot range;
7 a first write request to write to first data blocks, the first data blocks already cop-
8 ied in the snapshot;
9 in response to determining that the range of data bytes are in the snapshot range,
10 the system to determine if the range of data bytes have been written to the snapshot;
11 in response to determining that the range of data bytes have been written to the
12 snapshot, the first write request to be written to the source; and
13 in response to determining that the range of data bytes have not been written to
14 the snapshot, a process to copy the range of data bytes of the source to the snapshot, and
15 then the process to write the write request to the source.
16 a second write request to write to second data blocks, the second data blocks not
17 already copied in snapshot;
18 the second write request being placed into a first in first out queue; and
19 in response to completing the snapshot, writing the second write request from the
20 first in first out queue to the source.

1 41. (Currently Amended) The system of claim 40, further comprising:
2 wherein the replication manager process is executed on a file server and is oper-
3 able to control the source storage device controller and one or more other storage devices
4 device controllers.

1 42. (Currently Amended) The system of claim 40, further comprising:

2 a list of source data blocks to be copied that are reordered to increase copy speed.

1 43. (Currently Amended) The system of claim 42, further comprising:
2 ~~wherein the list of blocks to be copied is buffered while the storage device controller system~~ awaits further copy commands.

1 44. (Currently Amended) The system of claim 40, further comprising:
2 ~~wherein the replication manager process~~ is operable to ~~inserted~~ insert control data
3 before and after a source data block ~~being~~ is copied.

1 45. (Currently Amended) The system of claim 40, further comprising:
2 ~~wherein the replication manager process~~ is operable to specify a block size so that
3 the storage device controller system writes fixed-size blocks.

1 46. (Currently Amended) A method, comprising:
2 receiving a write request, ~~wherein the write request to modify has~~ a range of data
3 bytes in a source to modify;
4 determining ~~if~~ the range of bytes is within a snapshot range, ~~wherein a snapshot is~~
5 a process of copying data to a new location before the data is modified by a write opera-
6 tion;
7 determining that the range of bytes has not been written to a snapshot snapshot-
8 ted;
9 in response to determining that the range of bytes has not been written to a snap-
10 shot snapshotted, copying the range of bytes from a the source volume to a the snapshot
11 volume;

12 updating a **volume** snapshot map, wherein the snapshot map **determines** indicates
13 which blocks are located in the snapshot **volume**, **in response to** **copying** the **range** of
14 **bytes**; **and**
15 modifying the **range** of **bytes** of data in the source from the write request, **in re-**
16 **sponse to** **copying** the **range** of **bytes**; **and**
17 **copying** the **range** of **bytes** from the **source volume** to a **target volume** using the
18 **volume** snapshot map and data stored in the **snapshot volume**, and **copying** without hav-
19 **ing** a **file server** in the **path**.

Please add the following claims:

- 1 47. (New) The system of claims 23, further comprising:
 - 2 the write request being placed in a first in first out queue in response to determin-
 - 3 ing that the range of data bytes have not been written to the snapshot.

- 1 48. (New) The system of claims 31, further comprising:
 - 2 placing the write request in a first in first out queue in response to determining
 - 3 that the range of data bytes have not been written to the snapshot.

- 1 49. (New) A computer-readable media comprising instructions for execution in a proces-
- 2 sor for the practice of a method of operating a server comprising:
 - 3 receiving at the source the write request issued from a file system, the write re-
 - 4 quest specifying a first range of data bytes of the source, the write request being received
 - 5 while the source is being copied to the destination;
 - 6 in response to receiving the write request, holding the write request command in a
 - 7 cache, checking if the first range overlaps with the range specified by the snapshot and, if
 - 8 so, copying the first range from the source to the snapshot, updating the snapshot map,
 - 9 and then allowing the write request to write to the source.